REMARKS

I. Introduction

By the present Amendment, claims 1, 3-6, 8, 11, 13-16, and 18-21 have been amended. Claim 2 has been cancelled. Accordingly, claims 1 and 3-21 remain pending in the application. Claims 1 and 21 are independent.

II. Office Action Summary

In the Office Action of March 3, 2010, the Specification was objected to because of various informalities. The Drawings were objected to under 37 CFR §1.84(p)(4) because of various informalities. Claim 14 was objected to because of various informalities. Claims 9-21 were provisionally rejected on the ground of non-statutory obviousness double patenting as being unpatentable over claims 1-14 of co-pending application No. 11/577,005. Claims 9-21 were provisionally rejected on the ground of non-statutory obviousness type double patenting as being unpatentable over claims 1-18 of co-pending application No. 11/577,334. Claims 9-21 were provisionally rejected on the ground of non-statutory obviousness type double patenting as being unpatentable over claims 1 and 8 of co-pending application No. 11/913,959. Claims 9-21 were provisionally rejected on the ground of non-statutory obviousness type double patenting as being unpatentable over claims 1-18 of co-pending application No. 11/571,782. Claims 1-21 were rejected under 35 USC §112, first paragraph, as failing to comply with the written description requirement. Claims 6-20 were rejected under 35 USC §112, second paragraph, as being indefinite. Claims 1-21 were rejected under 35 USC §102(b) as being anticipated by U.S. Patent No. 6,381,197 issued to Savord et al. ("Savord"). These rejections are respectfully traversed.

The Specification was objected to because of various informalities. Regarding this objection, the Office Action indicates that page 3, line 15 recites "Patent Document 1:... ." which appears to be misplaced in reference to the remainder of the text. The Office Action suggests that the paragraph at line 15 should be placed after line 1.

By the present Amendment, Applicants have amended the Specification, as suggested in the Office Action, to move the paragraph starting at line 15 to line 2 of page 3.

Withdrawal of this objection is therefore respectfully requested.

III. Objection to the Drawings

The Drawings were objected to under 37 CFR §1.84(p)(4) because two different reference characters (14, 11) were used to designate the bias means. Specifically, the Office Action indicates that page 20 refers to the bias means using reference character 14, while Fig. 6 uses reference character 11 to identify the same component.

Concurrently submitted herewith, is a Replacement Drawing Sheet containing Figs. 6A and 6B. Fig. 6A has been amended to designate the bias means using reference character 14.

Withdrawal of this objection is therefore respectfully requested.

IV. Claim Objection

Claim 14 was objected to because of an informality. Regarding this objection, the Office Action indicates that claim 14 recites "the elements" when referring to the oscillation elements. The Office Action suggests that the term oscillation elements should be used consistently throughout the claims.

By the present Amendment, Applicants have amended claim 14 to replace the term elements with oscillation elements. Applicants have also reviewed the claims and made the same correction in other instances where the term "elements" was used.

Withdrawal of this objection is therefore respectfully requested.

V. Double Patenting Rejections

Claims 9-21 were provisionally rejected on the ground of non-statutory obviousness type double patenting as being unpatentable over either (1) claims 1-14 of co-pending application No. 11/577,005, (2) claims 1-18 of co-pending application No. 11/577,334, (3) claims 1 and 8 of co-pending application No. 11/913,959, or (4) claims 1-18 of co-pending application No. 11/571,782.

Since these rejections are provisional, Applicants elect to wait until the claims of either the instant application or the conflicting applications have been allowed, or indicated as allowable, in order to provide a response most appropriate to issued claims.

VI. Rejections under 35 USC §112

Claims 1-21 were rejected under 35 USC §112, first paragraph, as failing to comply with the written description requirement. Regarding this rejection, the Office Action indicates that the claims contain subject matter which was not described in the Specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors had possession of the claimed invention at the time the application was filed. In particular, the Office Action indicates that the term "means" is recited throughout the Specification without providing specific examples of what structure is defined by elements that contain this term.

Applicants respectfully disagree and request reconsideration and withdrawal of this rejection. It is noted that the Specification and Drawings reference and illustrate all of the terms mentioned in the Office Action. Hence, it appears that the Disclosure is not properly understood or is otherwise being misconstrued. For example, the receiving means is discussed at paragraph [0090] of the published application and identified using reference numeral 82. The image processing means and the bias means are discussed at paragraph [0038] and identified using reference numerals 20 and 14, respectively. The storage means is described at paragraph [0090] and identified as RAM 86-1 to 86-7.

Based on the foregoing, Applicants respectfully request reconsideration and withdrawal of this rejection.

Claims 6-20 were rejected under 35 USC §112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter regarded as the invention. Regarding the rejection, the Office Action indicates that claims 7, 9 , 10, and 17 recite claim elements such as "switching means", "transmitting means", which appear to invoke paragraph [0006] of §112. The Office Action indicates that it is unclear whether the claim is a means plus function or a modified structure. The Office Action goes on to suggest that the claim should be amended to recite "means for" or "step for". As previously described, the Specification discusses the switching means, transmitting means, receiving means, image processing means, etc. Consequently, Applicants should not be forced to amend the claims to recite something that is contrary to what is plainly recited in the Specification.

Regarding claim 8, the Office Action indicates that the phrase "formed by" did not appear to be directed to a method and it was unclear as to whether such a term

was inclusive or exclusive. Regarding claim 18, the Office Action indicates that the term "alternatively" appear to be indefinite or otherwise unclear. Claims 6 and 15 were indicated as reciting the limitation "the element", which lacked proper antecedent basis.

By the present Amendment, Applicants have amended claims 6, 8, 15, and 18 to address all of the issues of indefiniteness in the Office Action. Withdrawal of this rejection is therefore respectfully requested.

VII. Rejections under 35 USC §102

Claims 1-21 were rejected under 35 USC §102(b) as being anticipated by Savord. Regarding this rejection, the Office Action indicates that Savord discloses a plurality of transducers where it is inherent in the semiconductor silicon elements (MUT elements) has the characteristic of changing the electromechanical coupling coefficient in accordance with the strength of a direct-current bias. The Office Action goes on to indicate Savord discloses a plurality of oscillation elements of equal number being divided into a plurality of groups with equal intervals in a minor and major axis direction, that the disclosed distance between each MUT element can be varied for purposes such as aperture control, and that the gain of each MUT element can be varied to produce a different bias from each group for the purpose of apodization and elevation/image depth control. Savord is further indicated as disclosing a terminal with a distribution means which includes a switching means for selectively applying a bias voltage when ultrasonic waves are transmitted and received. Applicants respectfully disagree.

As amended, independent claim 1 defines an ultrasonic probe that includes a plurality of transducers in an array for converting drive signals into ultrasonic waves

to transmit the waves to an object to be inspected. The waves are then converted into electrical signals to receive ultrasonic waves generated from the object. According to independent claim 1:

> each of the transducers comprises a plurality of oscillation elements, each of the oscillation elements has a characteristic of changing an electromechanical coupling coefficient in accordance with strength of a direct-current bias applied by being superposed on the drive signal, and an electrode of each of the transducers is connected to a terminal provided with the drive signal, and
>
> the plurality of oscillation elements are divided into a plurality of groups, a number of the oscillation elements pertaining to each of the divided groups increases for each group as the element gets closer a center of an ultrasonic aperture.

The ultrasonic probe of independent claim 1 includes transducers which each includes a plurality of oscillation elements having a characteristic of changing an electromechanical coupling coefficient in accordance with the strength of a direct-current bias applied by being superposed on the drive signal. Each transducer also includes an electrode that is connected to a terminal provided with the drive signal. According to independent claim 1, the plurality of oscillation elements are divided into a plurality of groups, and a number of the oscillation elements pertaining to each of the divided groups increases for each group as the element gets closer to a center of the ultrasonic aperture. According to such an arrangement, it is possible to reduce the effects of the end part of the ultrasonic aperture while increasing the signal-to-noise ratio of the ultrasonic ultrasound image. Furthermore, the optimum ultrasound beams can be formed depending on the distance from the probe.

The Office Action alleges that Savord discloses all of the features recited in independent claim 1. Savord discloses a micro-machined ultrasonic transducer which has aperture, elevation, and apodization controlled by an apparatus located on

the same substrate as the transducer. Alternatively, a bias voltage control can be applied to the transducer elements. The control apparatus can take the form of field effect transistors, micro-machined relays, or doped regions on the substrate. Contrary to the ultrasonic probe of independent claim 1, Savord discloses a plurality of oscillation elements that are divided into a plurality of groups having an equal number of oscillation elements. There is no disclosure or suggestion for increasing the number of oscillation elements in each group as the oscillation elements get closer to the center of the ultrasonic aperture. Specifically, Savord provides no disclosure or suggestion for features now recited in independent claim 1, such as:

> the plurality of oscillation elements are divided into a plurality of groups, a number of the oscillation elements pertaining to each of the divided groups increases for each group as the element gets closer a center of an ultrasonic aperture.

It is therefore respectfully submitted that independent claim 1 is allowable over the art of record.

Claims 3-20 depend from independent claim 1, and are therefore believed allowable for at least the reasons set forth above with respect to independent claim 1. In addition, these claims each introduce novel elements that independently render them patentable over the art of record.

As amended, independent claim 21 defines a method for ultrasound images that comprises:

> a step for applying a direct-current bias to a plurality of oscillation elements possessed by each transducer arrayed in an ultrasonic probe and changing an electromechanical coupling coefficient of each of the oscillation elements to a setting value;
>
> a step for supplying a drive signal to each of the oscillation elements by superposing the drive signal on the direct-current bias, and the direct-current bias is supplied for each group in accordance with a distance from the ultrasonic probe to an imaging portion,

a step for transmitting an ultrasonic wave to an object to be inspected from each of the oscillation elements; and

a step for receiving an ultrasonic wave generated by the object by each of the oscillation elements to convert the wave into an electrical signal and reconstructing an ultrasound image based on the converted electrical signal.

According to the method of independent claim 21, a direct-current bias is applied to a plurality of oscillation elements in each transducer arrayed in an ultrasonic probe and the electromechanical coupling coefficient of each of the oscillation elements is changed to a setting value. A drive signal is then supplied to each of the oscillation elements by superposing the drive signal on the direct-current bias, and the direct-current bias is applied for each group in accordance with the distance from the ultrasonic probe to the imaging portion. The ultrasonic wave is transmitted to an object to be inspected from each of the oscillation elements. Finally, ultrasonic waves generated by the object are received and converted to electrical signals so that an ultrasound image can be constructed based on the converted electrical signals. As discussed with respect to independent claim 1, Savord does not appear to provide any disclosure or suggestion for varying the number of oscillation elements in each group relative to the distance from the center of the ultrasonic probe. Consequently, the direct-current bias applied to each group cannot be varied in accordance with the distance from the ultrasonic probe to the imaging portion.

It is therefore respectfully submitted that independent claim 21 is allowable over the art of record.

VIII. Conclusion

For the reasons stated above, it is respectfully submitted that all of the pending claims are now in condition for allowance. Therefore, the issuance of a Notice of Allowance is believed in order, and courteously solicited.

If the Examiner believes that there are any matters which can be resolved by way of either a personal or telephone interview, the Examiner is invited to contact Applicants' undersigned attorney at the number indicated below.

AUTHORIZATION

Applicants request any shortage or excess in fees in connection with the filing of this paper, including extension of time fees, and for which no other form of payment is offered, be charged or credited to Deposit Account No. 01-2135 (Case: 389.46065X00).

Respectfully submitted,
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Attachment: Replacement Drawing Sheet (1)